



Energy Systems Integration Facility (ESIF) Call for High-Impact Project Proposals

Informational Webinar, January 17, 2017

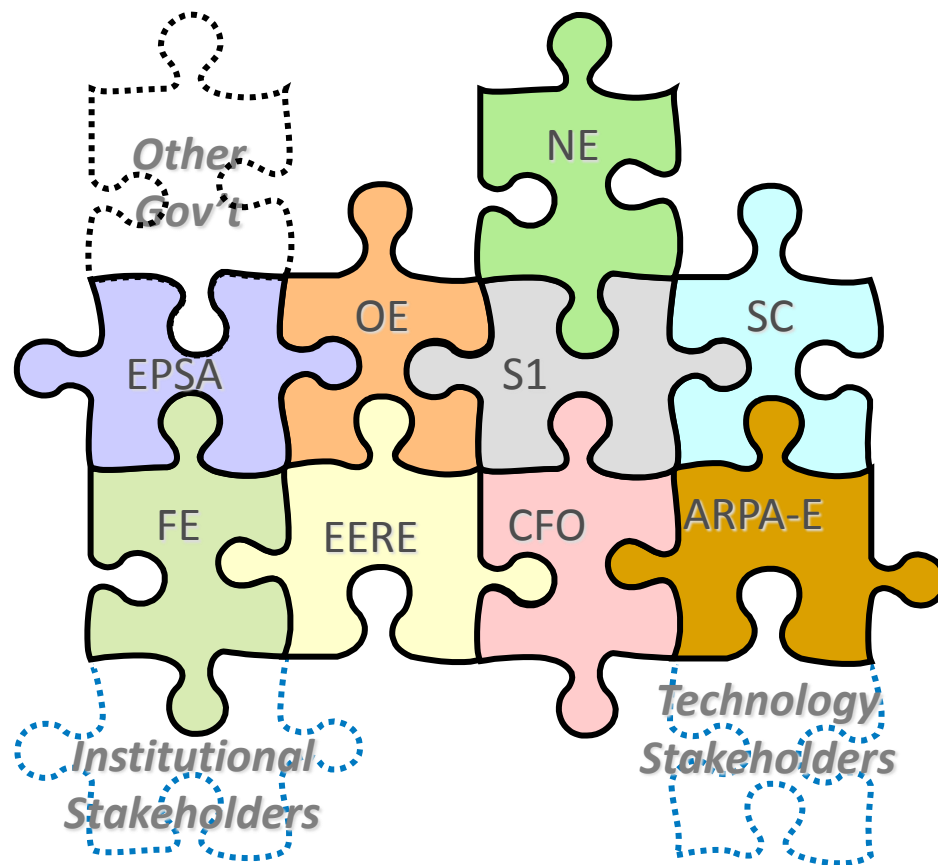
Agenda

- Background and Overview
- Technical Capabilities
- Proposal Package Details
- Q&A

U.S. Dept. of Energy's Grid Modernization Initiative

An aggressive five-year grid modernization strategy that provides a foundation for coordination across multiple DOE offices, national labs, academia and industry.

- Aligns existing base of DOE grid modernization activities
- Identifies new activities to fill R&D gaps in existing base
- Establishes a laboratory consortium with core scientific abilities and regional outreach
- Includes an integrated Multi-Year Program Plan (MYPP)



Refer to the [*DOE Grid Modernization Multi-Year Program Plan*](#) for more detail.

DOE Grid Modernization Initiative

The grid provides a critical platform for U.S. prosperity, competitiveness, and innovation. It must deliver reliable, affordable, and clean electricity to consumers where they want it, when they want it, how they want it.

The Grid Modernization Initiative aims to enable industry action that delivers:

- 10% reduction in the economic costs of power outages,
- 33% decrease in cost of reserve margins, (while maintaining reliability), and
- 50% decrease in net integration costs of distributed energy resources; all by 2025.



Impact: More than \$7 billion in annual economic benefit to the nation.

DOE-Designated National User Facility

NREL is home to the nation's only user facility equipped to support research and development aimed at optimizing our entire energy system, at full power.

A real-time link between ESIF and NWTC enables multi-MW scale grid integration experiments (up to 10 MW).



National Wind Tech. Center
(NWTC) in Boulder, CO

Energy Systems Integration
Facility (ESIF) in Golden, CO

Energy Systems Integration Facility (ESIF)



Addressing the challenges of large-scale integration of clean energy technologies into the energy systems infrastructure

<http://www.nrel.gov/esif>

"This new facility will allow for an even stronger partnership with manufacturers, utilities and researchers to help integrate more clean, renewable energy into a smarter, more reliable and more resilient power grid."
- Energy Secretary Ernest Moniz



- NREL's largest R&D facility (182,500 ft²/20,000 m²)
- Space for ~200 NREL staff and research partners
- Petascale HPC and data center
- Integrated electrical, thermal, fuel, water, and data infrastructure
- Labs focus on R&D of integrated energy systems
 - Electricity
 - Fuels
 - Transportation
 - Buildings

Call for High-Impact Projects Proposals

Objective: To partner with private sector innovators in developing scalable energy technologies that set the nation on a cost-effective path to a resilient, secure, sustainable and reliable grid that is flexible enough to provide an array of emerging services at an affordable price. (DOE Grid Modernization Initiative)

Solicitation Issued: Dec. 16, 2016

Proposals Due: Jan. 27, 2017 at 5 p.m. Eastern

Review and Selection: Feb. 1-15, 2017

Notification: End of February 2017

Negotiation of Awards: March-April 2017

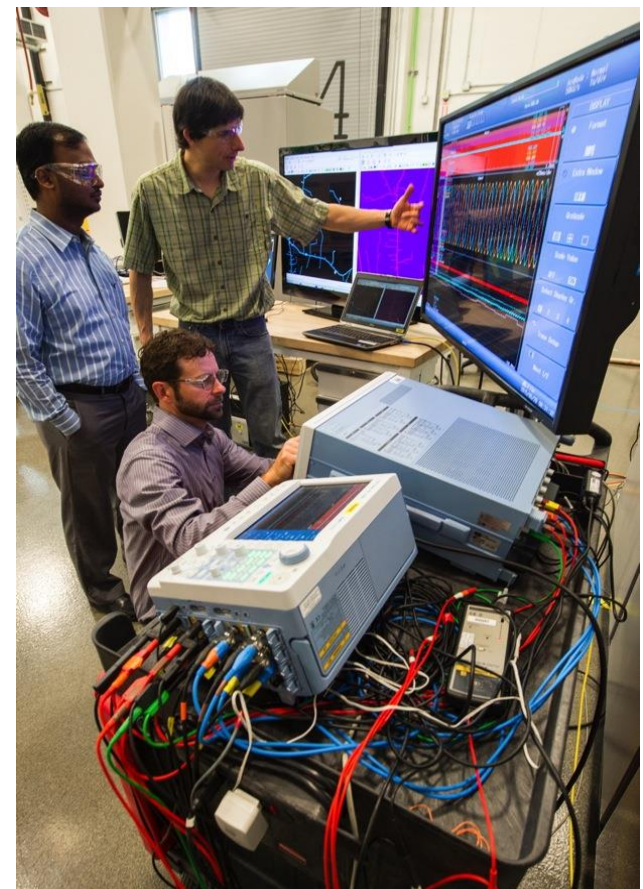
No. of Awards: Up to 5

Period of Performance: Up to 12 months

DOE Match Funding: Up to \$250k per project

Work may begin as early April 2017.

Apply at [FedBizOps.gov](https://www.fedbizops.gov)



NREL researchers working in the ESIF

Call for High-Impact Project Proposals

High Impact Projects must meet all of the following criteria to be considered:

1. Utilize multiple EERE technologies (e.g. storage, solar, wind, buildings, etc.)
2. Address challenges outlined in the [DOE Grid Modernization Multi-Year Program Plan](#) (MYPP)
3. Have demonstrable impact on the companies and regions it supports
4. Be nationally scalable
5. Result in lessons learned that could be implemented nationwide.



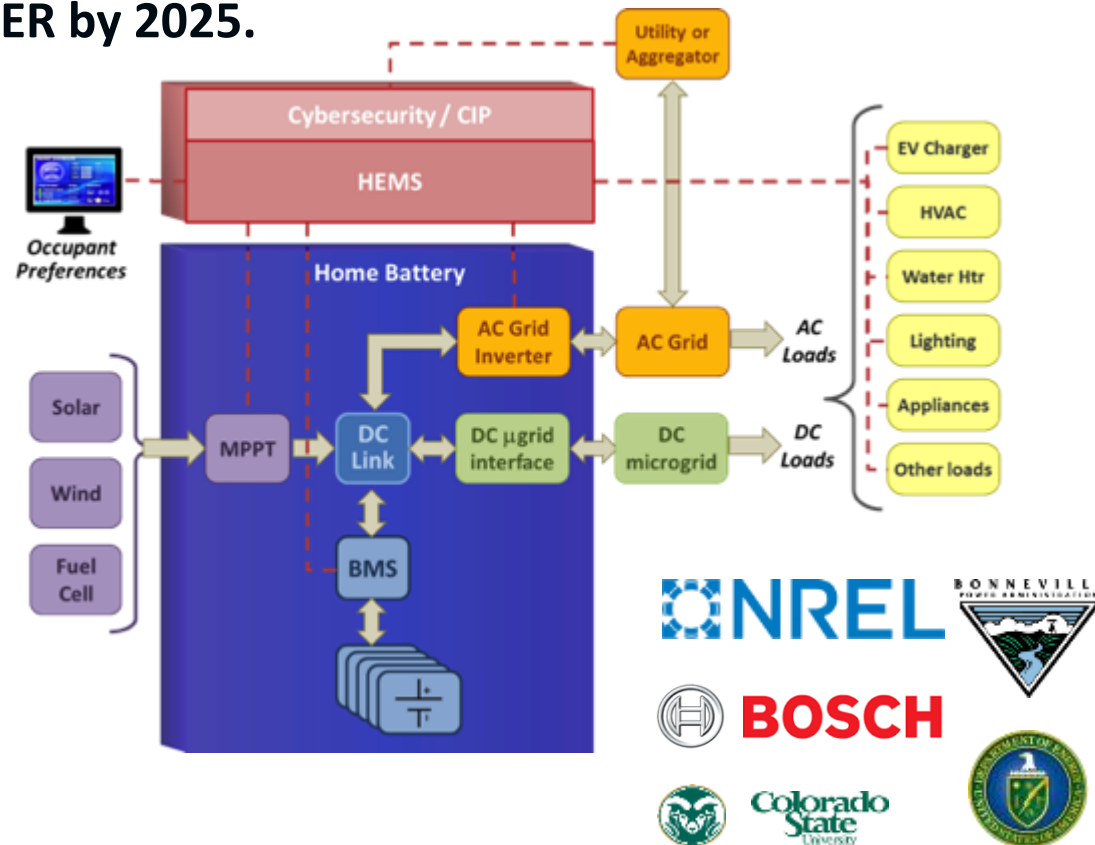
Energy Systems Integration Laboratory

High-Impact Project Example: Bosch & Bonneville Power Authority

Goal: Increase residential energy efficiency and demand response participation, by easing consumer adoption of integrated solutions, towards enabling 50% decrease in integration costs of DER by 2025.

Description: Develop and demonstrate homeowner-friendly controls, coupled with home battery and connected appliances, to demonstrate cyber-secure delivery of demand response and energy efficiency.

ESIF Activities: Develop and validate software for self-learning adaptive control of residential appliances and battery storage. Integrate developed software with actual devices.



Impact: Creates “win-win” solution for utilities, homeowners, and aggregators. Enables higher participation and may pave the way to fully controllable load, adding flexibility to the grid and leading to increased penetration of variable renewables.

High-Impact Project Example: Bosch & Bonneville Power Authority

High Impact Project Criteria	
Utilize multiple technologies	Buildings, Solar, Storage, Wind, Grid Services
Solve challenges outlined in MYPP	Percent decrease in the net integration costs of distributed energy resources; all by 2025 Develop advanced storage systems, power electronics, and other grid devices Conduct multi-scale systems integration and testing Increase ability to protect against threats and hazards
Impact of the companies and regions it supports	BPA, Bosch - represents national, even worldwide reach of impact; maximizes benefits of federally-owned hydro and transmission resources
Nationally scalable	Developed to meet needs of any homeowner and utility, not regionally or climate-specific
Develop lessons learned that could be implemented nationwide	Creates “win-win” solution for utilities, homeowners, and aggregators. Paves the way to fully controllable load, adding flexibility to the grid and leading to increased penetration of variable renewables

Technical Capabilities

ESIF – A Self-Contained Energy System

Rooftop Test Area
Wind, Solar



Energy Storage Lab
Batteries and Thermal
Energy Storage



System Performance Lab
Residential Buildings & Loads



Optical Characterization Lab
Commercial Buildings & Loads



Outdoor Test Area

**Hydrogen Systems
Integration Lab**
Fuel Cells, Electrolyzers



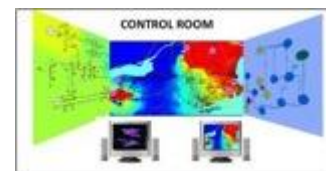
Outdoor Test Areas
EVs, Power Transformers,
Microturbines, Generators



**Power Systems
Integration Lab**
Power Electronics, Microgrids



Control Room
ADMS Testbed



ESIF Research Infrastructure

- ❗ Research Electrical Distribution Bus – REDB (AC 3ph, 600V, 1200A and DC +/-500V, 1200A)
- 🔌 Thermal Distribution Bus
- 💧 Fuel Distribution Bus
- 🖥 Supervisory Control and Data Acquisition (SCADA)

Research Electrical Distribution Busway for Laboratory Access



1MW Grid Simulator

250A DC
1600A DC

Direct Current
Research Electrical
Equipment Room

Alternating Current
Research Electrical
Equipment Room

House
Power

250A AC
1600A AC



ESIF – Power Systems Integration Lab

Research in the Power Systems Integration Laboratory focuses on the development and testing of large-scale distributed energy systems for grid-connected, standalone, and microgrid applications. The laboratory can accommodate large power system components, such as inverters for PV and wind systems, diesel and natural gas generators, battery packs, microgrid interconnection switchgear, and vehicles.



Lab Functions

- Main test lab for conducting MW-scale electrical system integration activities.
- Research explores a variety of operating configurations including: grid connected stand-alone, microgrids, and hybrid power systems.
- House infrastructure for DG research (AC and DC power supplies for REDB, chiller and boiler)

Major Lab Equipment

- 1 MW grid simulator
- 1.5MW PV Array Simulator
- 100kW PV Array Simulator
- Several 250kW DC power supplies
- 100 ton research chiller
- 750MBH research boiler
- Connections to Research Electrical, Thermal, Fuel Buses

ESIF – Systems Performance Lab

Research in the Systems Performance Laboratory focuses on the development and integration of smart, connected technologies, including distributed and renewable energy resources and smart energy management. The 5,300-ft² laboratory is designed to be highly flexible and configurable to enable a range of smart power activities—from developing advanced inverters and power converters to testing residential- and commercial-scale meters and control technologies.



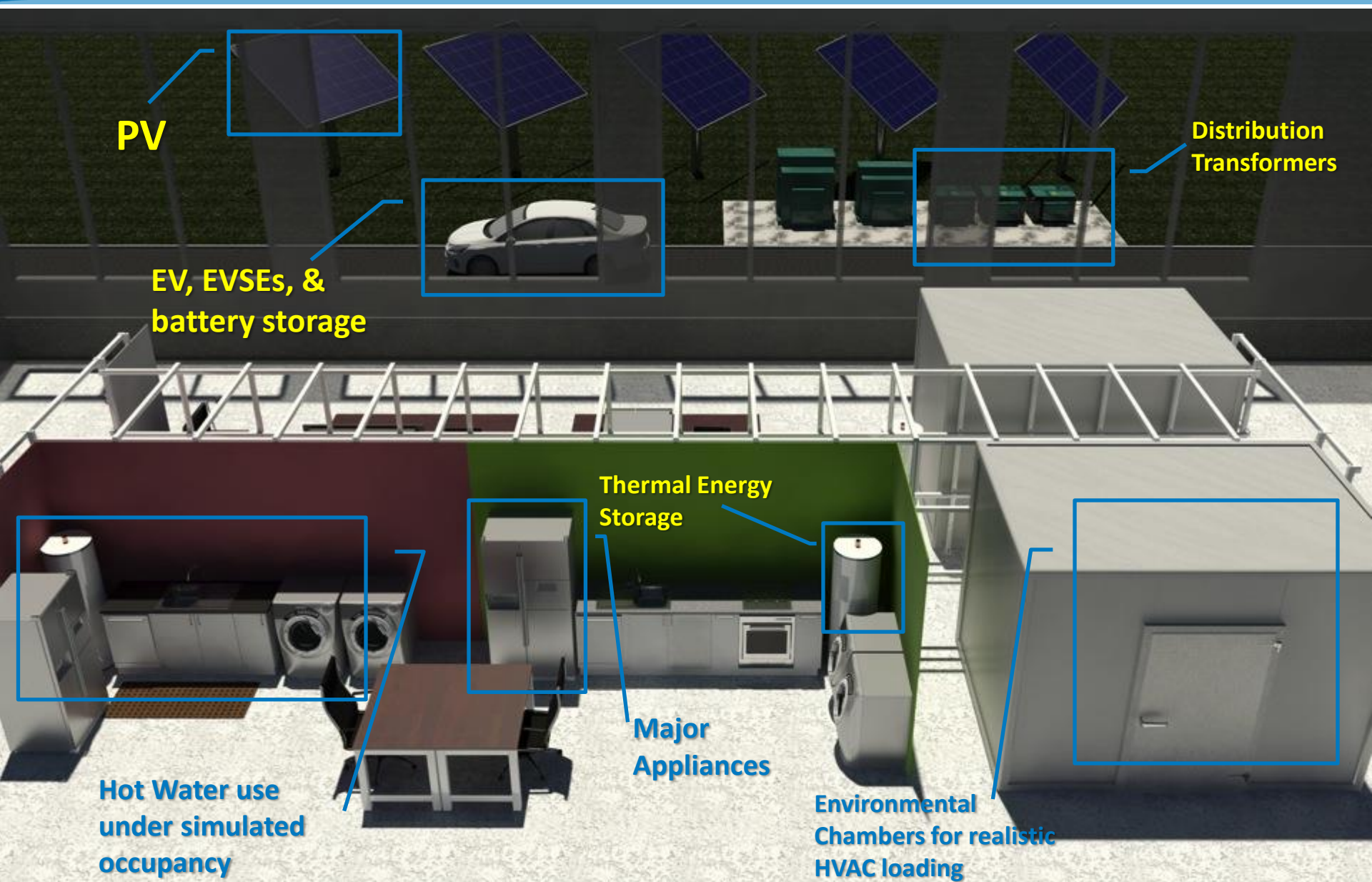
Lab Functions

- Residential scale distributed resources, smart appliances, and HVAC evaluations
- Interoperability and communications testing
- Individual Test labs for development and testing of the power electronics components and circuits used in renewable energy integration
- Instrument development area for basic electronics work

Major Lab Equipment

- AC power supplies
- 45kW and 15kW grid simulators
- Opal RT and RTDS Hardware-in-the-Loop Systems
- Connections to REDB
- 3 Smart home appliances (refrigerators, water heaters, dish washers, etc.)
- 2 environmental chambers to test small HVAC systems

ESIF – Systems Performance Lab



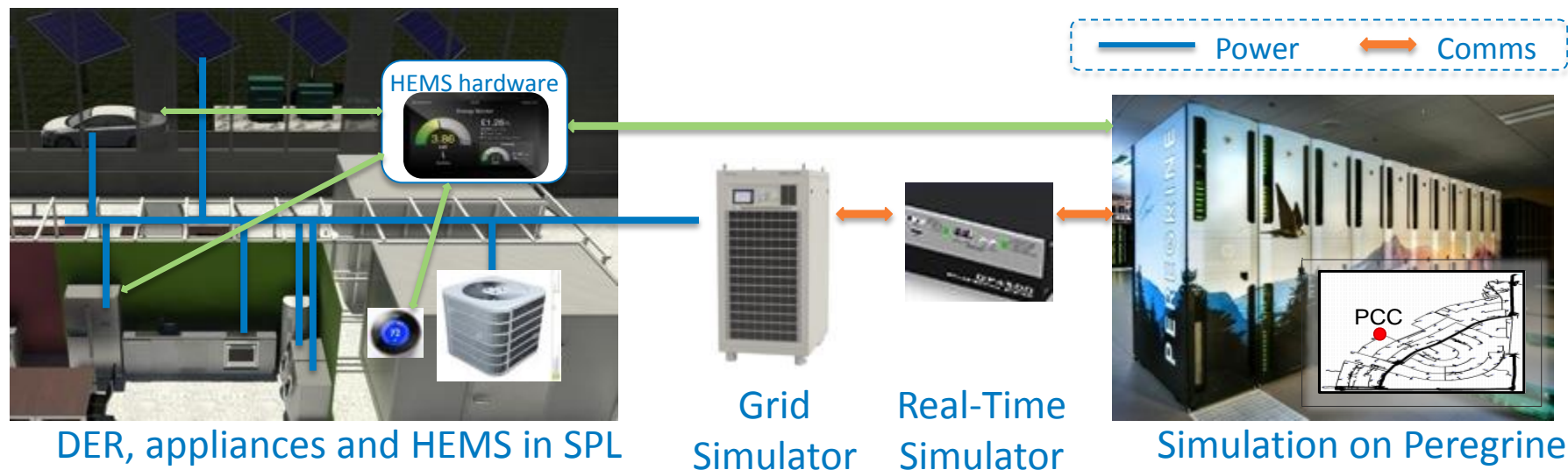
Home Energy Management Systems

Capabilities

- Smart Home Hardware-in-the-loop – includes appliances, HVAC, PV, EV
- Centralized optimization (within home/buildings) based on Model Predictive Controls (MPC)
- Simulation of aggregated homes with distribution systems – including market signals

IMPACT

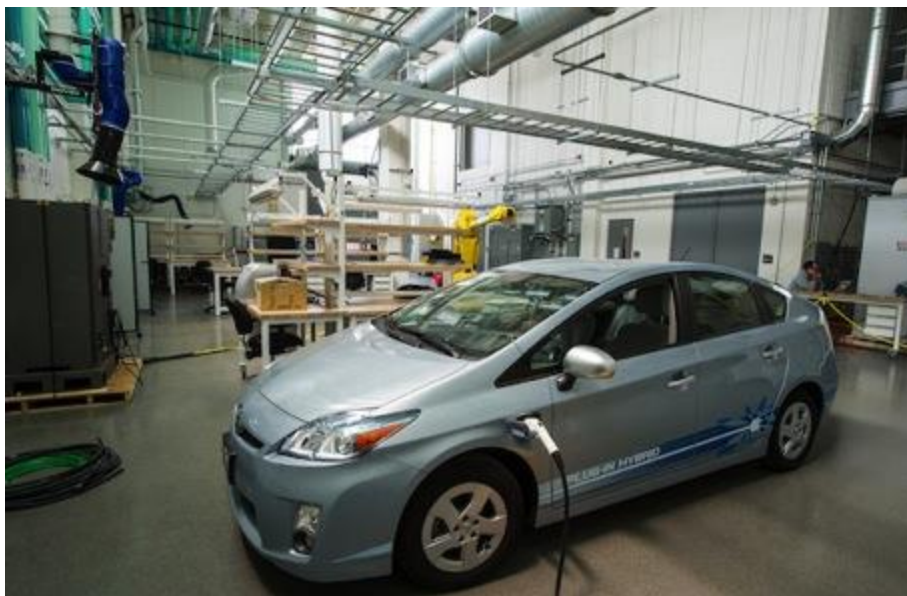
Provide a test bed that allows complete system optimization from appliances to aggregators to system operations



<http://www.nrel.gov/docs/fy15osti/64365.pdf>

ESIF – Energy Storage Lab

At the Energy Storage Laboratory, research focuses on the integration of energy storage systems (stationary and vehicle-mounted) and their interconnection with the utility grid. Includes batteries, ultra-capacitors, flywheels, compressed air, etc.



Lab Functions

- Testing energy storage components when integrated with renewable energy electrical systems:
 - Performance
 - Efficiency
 - Safety
 - Model validation
 - Long duration reliably

Major Lab Equipment

- DC Power Testing station 250 kW, up to 900 Vdc
- Grid Simulator connections
- REDB Connections
- Research Chiller & Boiler
- 600kW PV Simulator
- EV Chargers

ESIF – Outdoor Test Area

The outdoor test areas at the ESIF allow for testing either at 480 Volts or 13.2 kiloVolts



MV Major Lab Equipment

- 1MVA 13.2kV to 480 Y-Y transformers
- Connections to REDB, Utility
- Distribution transformers
- EV Chargers

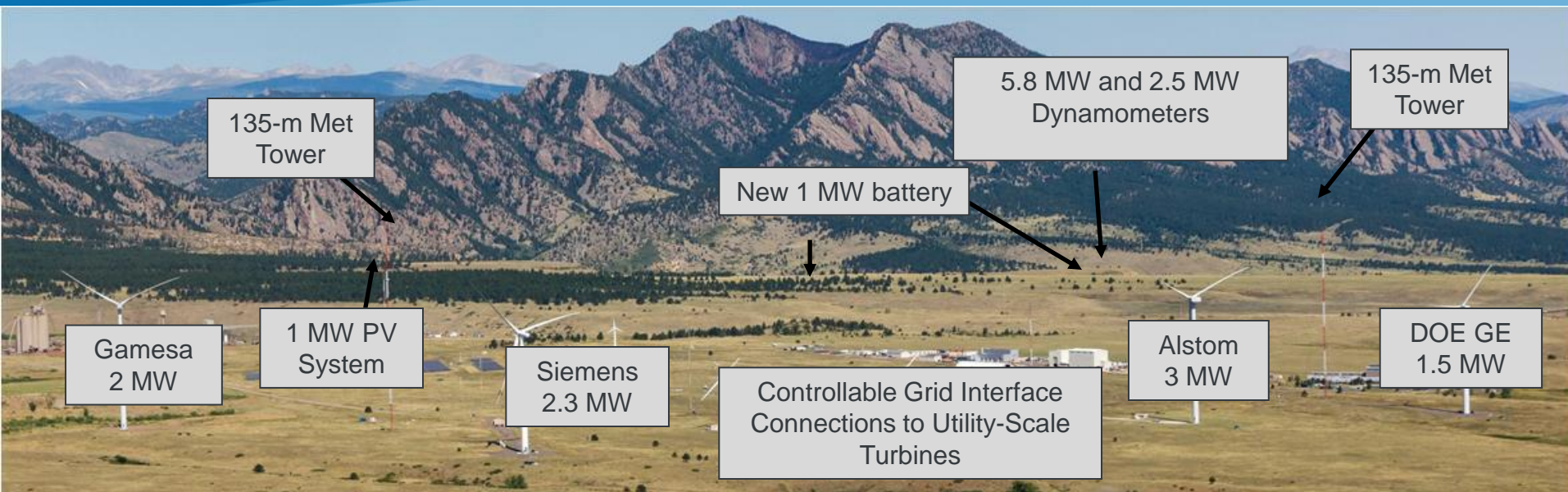
LV Major Lab Equipment

- 80kW and 125kW Gensets
- 100kW, 250kW load banks
- Capstone Microturbine
- Connections to REDB

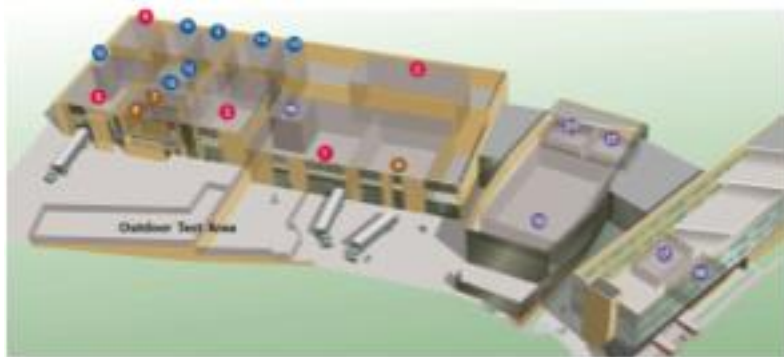
ESIL Major Lab Equipment

- H₂ storage vessels
- H₂ IC engine testing
- H₂ Vehicle fueling station

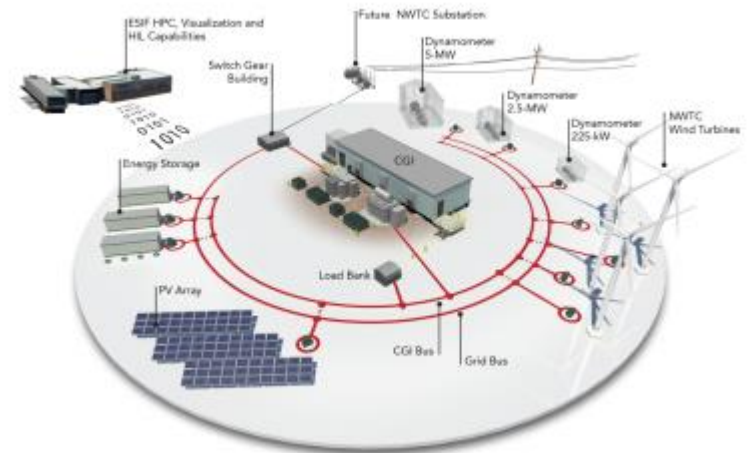
NWTC Grid Integration



Controllable Grid Interface (CGI) allows Advanced grid testing at 7MVA continuous

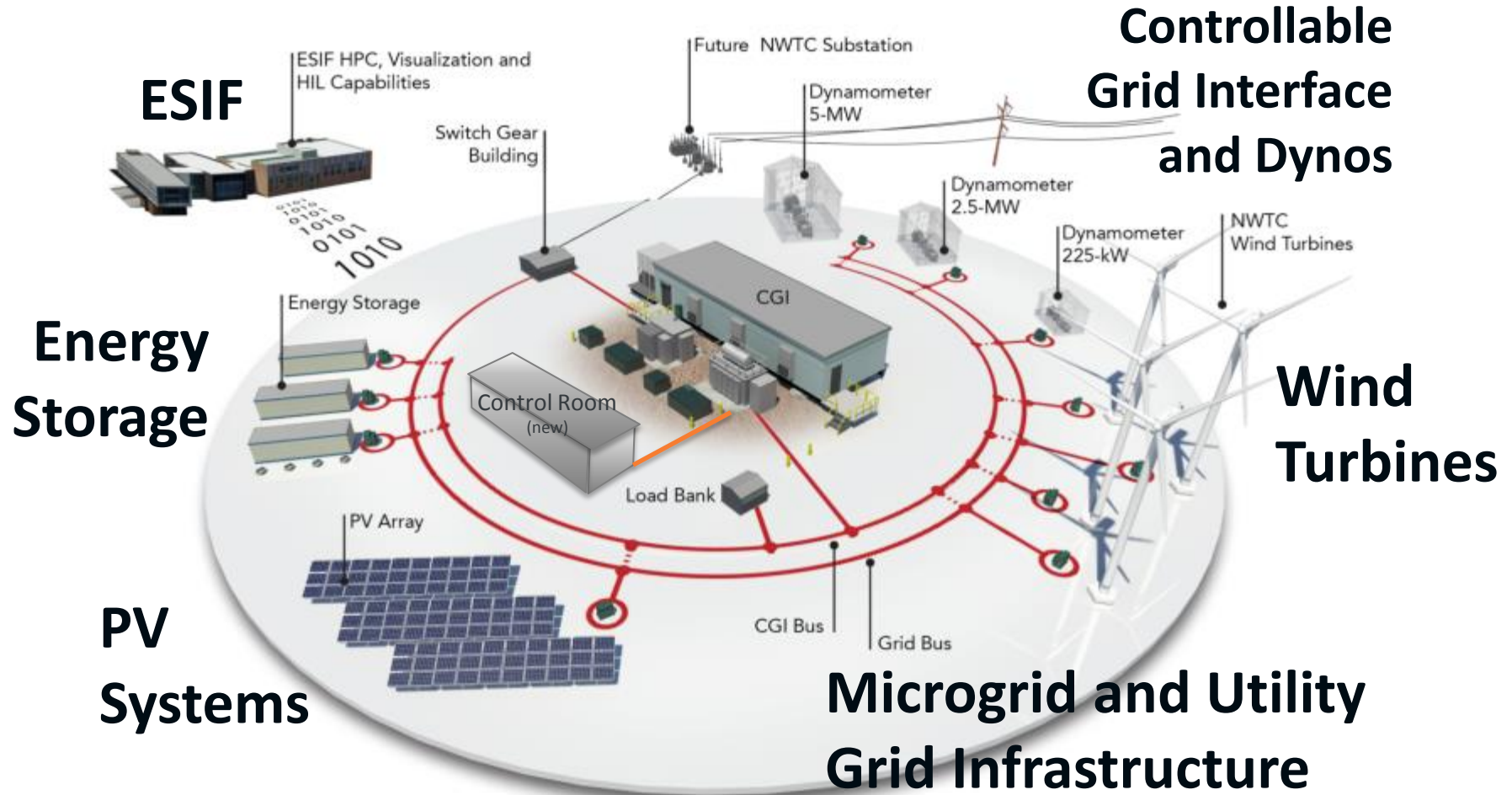


Energy Systems Integration Facility



NWTC Grid Integration

NWTC is a World Class Grid Integration R&D Facility



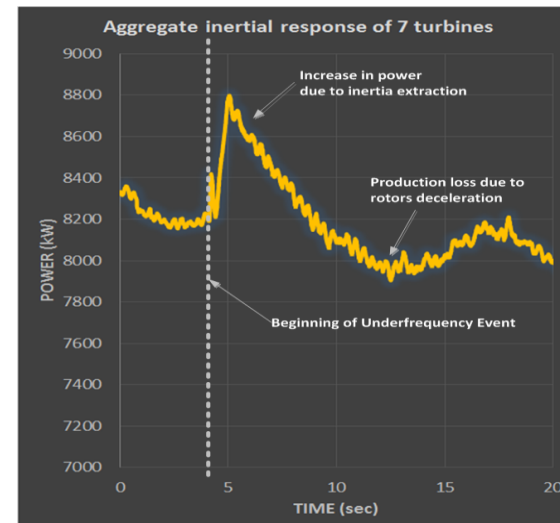
Leverages staff expertise and research facilities enabling an integrated research environment for full-scale R&D of renewable energy systems at transmission and distribution grid levels

NWTC Grid Integration Offers Unique Capabilities

- Compliments and extends ESIF capabilities with multi-MW wind, solar, and storage
- Provides unique transmission level R&D platform for projects
- System integration of renewables with MW energy storage
- Validation of power system modeling and controls research
- Simulation of abnormal grid conditions including microgrid integration



Key NWTC Grid Integration Asset NWTC 7-MVA Controllable Grid Interface



Wind plant of one showing wind inertia control

Call for High-Impact Project Proposals

Proposal Details

Eligibility

Types of Entities:

- For profit or nonprofit entities
- State, local, tribal governments
- Government laboratories
- Non-DOE Federal agencies
- Consortia- incorporated or unincorporated

Domestic entities are organized according to the laws of any of the 50 states, the District of Columbia, or any U.S. territory or possession.

Foreign entities may apply if they designate a U.S.-based subsidiary of the entity to serve as the prime applicant.

Proposal Package

- Cover page (1 page)
 - Proposal title and abstract
 - Research team information
 - ESIF facilities desired
 - Total project budget (applicant contribution+ DOE match funding)
- Body (4 pages)
 - Project description
 - Market opportunity assessment
 - Impact and alignment
 - Commercialization and dissemination plan
 - Cost share summary
- Gantt Chart (1 page)
- Resumes (1 page for each participant)



Applicants are required to adhere to all formatting specifications listed in the Call for High-Impact Project Proposals.

Funding and Cost Share Details

DOE Funding: Up to \$250,000 is available to support NREL staff working on each selected project.

Cost Share Details:

- Applicants are required to provide at least 50% cost share.
- Allowable cost share includes expenditures that are directly beneficial, specifically identifiable, and necessary for performance of this specific project.
- DOE funding may be subcontracted (by NREL) to a third party if the work done by the third party will enhance the proposed high-impact project and capabilities of the ESIF.
- The prime applicant is not eligible to receive funding through a subcontract.

Sample Budget		
Applicant Cost Share	DOE Match	Total Project Value
\$200,000	\$200,000	\$400,000

ESIF Engineering and Operations staff will ensure proper set-up and decommissioning of the project and provide training and oversight associated with safe operations of ESIF laboratories and equipment.

Review and Negotiation Process

Review Criteria

- Alignment and impact (60%)
- Appropriateness of the proposed method or approach (30%)
- Competency of the project team (10%)

Budgeting Process

- Applicant will propose a scope of work for the applicant team and NREL researchers to perform together in the ESIF
- NREL staff will provide the applicant with a proposed budget for the NREL portion if the project is selected for negotiation

Terms and Conditions

- Awardees will enter into a Cooperative Research and Development Agreement (CRADA) with NREL
- Publication is expected at the end of the project

Schedule of Key Dates

Request for Proposals Issue Date	Dec 16, 2016
Informational Webinar	Jan 17, 2017
Proposal Due Date	Jan 27, 2017
Initial Evaluation / Compliance Review	Jan 30 - Feb 1, 2017
Technical Merit Review	Feb 1-10, 2017
Consensus Call	Feb 14, 2017
DOE Briefing and Final Selection	Feb 16, 2017
Notifications	End of February 2017
Final Negotiations	March- April 2017
Written consensus comments provided to all applicants	March 2017

Questions?

- Questions that are emailed to sarah.truitt@nrel.gov by 5 p.m. Eastern on January 25, 2017 will be answered on the ESIF FAQ page.
- NREL will make every effort to answer questions as they come in and post answers to the ESIF FAQ page at www.nrel.gov/esif/faq-user-call.html within 2 business days of receipt.



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